



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/019,746

06/19/2002

John Canning

P07477US00/MP

4409

881

7590

05/19/2004

STITES & HARBISON PLLC
1199 NORTH FAIRFAX STREET
SUITE 900
ALEXANDRIA, VA 22314

EXAMINER

DONG, DALEI

ART UNIT

PAPER NUMBER

2879

DATE MAILED: 05/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/019,746	CANNING, JOHN	
	Examiner	Art Unit	
	Dalei Dong	2879	<i>AW</i>

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 April 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 and 18-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 and 18-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 June 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-16, 18-26, 33 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,388,173 to Glenn in view of U.S. Patent No. 5,367,588 to Hill.

Regarding to claims 1-16, 18-22, 33 and 36, Glenn discloses in Figure 1, "a tunable wavelength laser 10 provides a source beam 12 having a wavelength based on a signal on a line 14 from a controller 16 (discussed hereinafter). The light 12 is incident on an amplitude modulator 18, e.g., an electro-optic amplitude modulator or a spatial light modulator. The amplitude modulator 18 adjusts the amplitude of the input light signal 12 and provides a light signal 20 having an amplitude in response to an amplitude control signal on a line 21 from the controller 16" (column 3, line 64 to column 4, line 5).

Glenn also discloses in Figure 1, "The reflected beam 25 is incident on a phase modulator 34, e.g., an electro-optic phase modulator, which provides an output beam 36 being phase shifted from the input beam 25 in response to a signal on a line 38 from the controller 16. The phase shifted beam 36 is incident on a mirror 40 which provides a reflected beam 42. The reflected beam 42 is also incident on the region 30 of the optical fiber 32 and intersects with and interferes with the beam 28. Alternatively, a fixed phase

modulator may be used if desired, such as a phase plate. It should be understood that the phase modulator 34 may alternatively be placed in the path of the beams 24, 28, or 42" (column 4, lines 14-26).

Glenn further discloses in Figure 5, "the mirror 100 provides a reflected collimated beam 108 having an angle α relative to the angle of the mirror 100. The beam 108 is incident on a lens 110 which focusses and directs light entering the lens from various different angles to provide output light 112 having substantially parallel central rays. The light 112 is incident on a collimating lens 114, which collimates and directs the light 112 as an output light 116 to a region 30 of the fiber 32 which is located at the focal plane of the lens 114" (column 6, lines 8-17).

Glen further yet discloses in Figure 5, "the distance between where the light 108 leaves the mirror 100 and the lens 110 is equal to the focal length f_1 of the lens 110. The distance between the lens 114 and the fiber 32 is equal to the focal length f_2 of the lens 114. Also, the distance between the lens 110 and the lens 114 is equal to the sum of the two focal lengths f_1, f_2 of the lenses 110, 114, respectively. To have a change in the angle α cause the same change in the angle θ onto the fiber, the focal lengths f_1, f_2 should be the same; however, this is not required for the invention to operate" (column 6, lines 18-27).

Glen furthermore discloses in Figure 5, "a similar arrangement exists between the adjustable mirror 102 and the fiber 32. In particular, a light 120 is reflected from the mirror 102 and is incident on a focussing and redirecting lens 122 which provides a focussed output light 124 (similar to the focussed beam 112 of FIG. 6). The focussed

light 124 is incident on a collimating lens 126 which provides a collimated light beam 128 onto the region 30 of the fiber 32" (column 6, lines 28-36).

However, Glen does not disclose the divided the input coherent beam are different orders. Hill teaches "the fabrication of optical waveguide devices such as intra-mode retro-reflecting Bragg gratings, mode convertor gratings, and rocking rotators have been achieved. The general approach for making these devices is to photoinduce a refractive index grating in the photosensitive core of the optical waveguide. The grating consists of a periodic modulation of the core's refractive index along the length of the waveguide. The period of the perturbation is chosen to bridge the momentum (propagation constant) mismatch between the two (normally bound) modes that the grating is designed to couple. At the resonant wavelength of the structure, phase-matched, efficient, power exchange between the coupled modes is possible" (column 1, lines 21-35).

Hill also teaches in Figure 1, "A phase grating slit-mask 1 is used in a precision photolithographic apparatus and is placed in contact, or near-contact, with an optical fiber 3, its grating striations 5 (as illustrated in magnification 6 of the mask) directed normal or near normal to the fiber axis. A UV light beam 7 from a suitable laser, a KrF excimer laser (249 nm) in a successful prototype is passed through the mask 1 by which it is phase modulated spatially and is diffracted to form an interference pattern 9A laterally (Bragg grating pitch) and along the incident laser beam direction 9B (Talbot pitch) as illustrated in magnification 11 of the core of the fiber" (column 3, lines 36-47).

Hill further teaches in Figure 1, "the slit-mask preferably is comprised of a one dimensional surface-relief structure as shown at 6 fabricated in a high quality fused silica

flat transparent to the KrF excimer laser radiation. The shape of the periodic surface-relief pattern of the phase mask preferably approximates a square wave in profile, as shown at 6. The amplitude of the periodic surface-relief pattern is chosen to modulate by $\pi + 2\pi n$ radians ($n=0,1,2,3, \dots$) the phase of the UV light beam. In a successful prototype of the phase mask for a KrF excimer laser beam, the amplitude A of the surface relief pattern is given by $A = \frac{\lambda}{2(n_{\text{silica}} - 1)}$ where λ is the wavelength of the light used for writing (photoinducing) an index change in the optical medium, and n_{silica} is the refractive index of the silica used in forming the mask. This choice of surface-relief-grating amplitude results in a grating diffraction pattern for the design wavelength that nulls the zero-order diffracted (through) beam. In practice, the zero-order beam has been suppressed to less than 5% of the light diffracted by the mask. The principal beams exiting our mask are the diverging plus-one and minus-one orders each of which contained typically more than 35% of the diffracted light" (column 3, line 48 to column 4, line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the phase mask with one dimensional surface-relief structure of Hill for the apparatus for writing grating of Glenn in order to achieve high accuracy in the translation of the optical fiber in front of the slit and permit the writing of several index perturbations in a single operation and thus reduce the exposure time of the grating.

Regarding to claims 23-26, Glenn discloses in Figure 3, "by performing successive writings of interference patterns having different amplitude, phase and frequency of spatial variations (and thereby producing correspondingly different periodic refractive index variations), an aperiodic refractive index profile can be created, thereby allowing for filter shapes other than a single narrow band reflection filter" (column 4, lines 56-63). Furthermore, it has been held that a recitation with respect to the manner in which a claimed apparatus and method is intended to be employed does not differentiate the claimed apparatus and method from a prior art apparatus satisfying the claimed structural and methodical limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

3. Claims 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,388,173 to Glenn in view of U.S. Patent No. 5,367,588 to Hill in further view of 4,466,694 to MacDonald.

Regarding to claims 27-29, Glenn in view of Hill discloses a method of forming grating structure in a photosensitive waveguide, the method comprising the steps of: dividing an input coherent beam into at least three coherent beams; transmitting the at least three beams through respective optical paths in a manner such that they interfere at predetermined positions; placing the photosensitive waveguide at the predetermined position; and modulating/adjusting the relative phase and/or the intensity of at least one of the at least three coherent beams so as to form the grating structure comprising superimposed gratings of different orders with respect to a certain wavelength at the

predetermined position through refractive index changes induced in the photosensitive waveguide.

However, neither Glenn nor Hill discloses the grating structure is used in an optical free space coupler. MacDonald teaches in Figure 1, "a planar optical waveguide 1 which may form part of or be coupled to an optical fiber. Corrugations 2 are formed in a wall of the waveguide. Enclosing the waveguide around the corrugations is a cavity resonator 3 of the Fabry-Perot type, in which the axis of the resonator is transverse to that of the waveguide" (column 2, lines 22-28).

MacDonald also teaches in Figure 1, "the resonator is comprised of reflectors 4 and 5, one of which, shown as reflector 4, on the side adjacent the corrugations, is made leaky to optical radiation such that power which is coupled into the resonator leaks out faster than the power remaining in the waveguide" (column 2, lines 29-33).

MacDonald further teaches in Figure 2, "the corrugations in the waveguide are made aperiodic, with a gradually diminishing period for example, such that a band of signals of controlled optical bandwidth could be coupled out. For the same purpose, the width of the waveguide can be varied along the length of the coupler, as shown in FIG. 3. These couplers can also act as wavelength-selective filters of controllable properties. FIG. 4 shows another variation using a tandem arrangement of corrugations of different periods for coupling a plurality of wavelengths sequentially out of the waveguide" (column 2, line 63 to column 3, line 5).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the phase mask with one dimensional surface-relief

structure of Hill for the apparatus for writing grating of Glenn to utilize in the coupling system of MacDonald in order to achieve high accuracy in the translation of the optical fiber in front of the slit and permit the writing of several index perturbations in a single operation and thus reduce the exposure time of the grating and furthermore achieve greater control of wavelength selectivity and permits single light-waveguide to be used as the carrier medium for a plurality of different signals.

4. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,388,173 to Glenn in view of U.S. Patent No. 5,367,588 to Hill in further view of 5,757,487 to Kersey.

Regarding to claims 30-32, Glenn in view of Hill discloses a method of forming grating structure in a photosensitive waveguide, the method comprising the steps of: dividing an input coherent beam into at least three coherent beams; transmitting the at least three beams through respective optical paths in a manner such that they interfere at predetermined positions; placing the photosensitive waveguide at the predetermined position; and modulating/adjusting the relative phase and/or the intensity of at least one of the at least three coherent beams so as to form the grating structure comprising superimposed gratings of different orders with respect to a certain wavelength at the predetermined position through refractive index changes induced in the photosensitive waveguide.

However, neither Glenn nor Hill discloses the optical waveguide is used as a sensing device. Kersey teaches in Figure 1, "the sensor array 11 comprises a series of

weakly reflecting ($\leq 1\%$) broadband grating elements 13 at a set of nominal wavelengths λ_1 to λ_m . The grating elements 13 can be arranged either in serial groups at each wavelength as illustrated in FIG. 1, or as interleaved wavelength sets as shown in FIG. 2. The grating elements 13 are sensors. They are designed to reflect over a broadband of wavelengths either by utilizing short gratings (e.g., a 100 μm long un-chirped grating produces a grating with a bandwidth of ~ 10 nm at a nominal wavelength of ~ 1.3 μm), or by using symmetric or asymmetric, aperiodic (chirped) grating elements 13. Preferably, they are of the linear edge fiber Bragg grating type. Illustratively, they are sensing the strain in the body (not shown) on which they are mounted" (column 3, lines 1-15).

Kersey also teaches in Figure 1, "pulses of light from a series of lasers 14, 15, 16 . . . N, each at the nominal wavelengths of the grating wavelengths λ_1 , λ_2 , λ_3 , to λ_n is injected through a wavelength combining device, a wavelength multiplexer 21, and the combined optical signal is coupled into the sensing fiber 23 through directional coupler 25. The light pulses are reflected off the series of broadband gratings 13 in the fiber 23 and produce a 'train' of reflected pulses. After reverse passage of the reflected pulses through the directional coupler 25, a second wavelength multiplexer 27 is connected to receive the reflected pulse train and to divide the wavelengths back out onto separate fiber 'channels', illustratively 31, 33, 35, and 37 for wavelengths λ_1 to λ_4 , each of which is fed to an associated one of detectors 41, 43, and so forth. Each detector 'sees' a train of pulses reflected from the

grating elements in the array 11, each grating element being written at the nominal wavelength corresponding to its channel" (column 3, lines 16-33).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the phase mask with one dimensional surface-relief structure of Hill for the apparatus for writing grating of Glenn to utilize in the sensor array of Kersey in order to achieve high accuracy in the translation of the optical fiber in front of the slit and permit the writing of several index perturbations in a single operation and thus reduce the exposure time of the grating and furthermore resolving a large number of concurrent signals at the relatively low power levels.

5. Claims 34-35 and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,388,173 to Glenn in view of U.S. Patent No. 5,367,588 to Hill in further view of 6,292,603 to Mizuochi.

Regarding to claims 34-35 and 37-41, Glenn in view of Hill discloses a method of forming grating structure in a photosensitive waveguide, the method comprising the steps of: dividing an input coherent beam into at least three coherent beams; transmitting the at least three beams through respective optical paths in a manner such that they interfere at predetermined positions; placing the photosensitive waveguide at the predetermined position; and modulating/adjusting the relative phase and/or the intensity of at least one of the at least three coherent beams so as to form the grating structure comprising superimposed gratings of different orders with respect to a certain wavelength at the

predetermined position through refractive index changes induced in the photosensitive waveguide.

However, neither Glenn nor Hill discloses the optical waveguide is used as a dispersion compensator. Mizuochi teaches in Figure 1, "a dispersion compensation device according to a first embodiment of the present invention. In the figure, reference numeral 1 denotes a dispersion compensation device, 2 denotes a first input terminal for receiving a lightwave signal with a wavelength of λ_{-i} which requires a positive dispersion compensation, 3 denotes a first output terminal via which the dispersion-compensated lightwave signal with a wavelength of λ_{-i} is furnished, 4 denotes a second input terminal for receiving a lightwave signal with a wavelength of λ_{+i} which requires a negative dispersion compensation, and 5 denotes a second output terminal via which the dispersion-compensated lightwave signal with a wavelength of λ_{+i} is furnished. In addition, reference numeral 6 denotes a chirped grating fiber, 7a denotes a first optical circulator having an intermediate terminal connected to one end portion of the chirped grating fiber 6 with a smaller grating pitch (or spacing) as compared with that of the other end portion of the chirped grating fiber 6, and 7b denotes a second optical circulator having an intermediate terminal connected to the other portion of the chirped grating fiber 6 with a larger grating pitch. The first optical circulator 7a has an input terminal connected to the first input terminal 2 and an output terminal connected to the first output terminal 3. Similarly, the second optical circulator 7b has an input terminal connected to the second input terminal 4 and an output terminal connected to the second output terminal 5. The dispersion

compensation device 1 thus can introduce dispersion compensations of the same absolute amount but of opposite sign into both two input lightwave signals applied thereto by way of the first and second input terminals, respectively, by bidirectionally guiding them to the single chirped grating fiber 6 from the two ends of the chirped grating fiber, respectively. In this specification, the dispersion compensation device 1 is hereafter referred to as BiDCG (or Bipolar Dispersion compensation Grating)" (column 7, lines 2-37).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the phase mask with one dimensional surface-relief structure of Hill for the apparatus for writing grating of Glenn to utilize in the dispersion compensation device of Mizuochi in order to achieve high accuracy in the translation of the optical fiber in front of the slit and permit the writing of several index perturbations in a single operation and thus reduce the exposure time of the grating and furthermore increasing the efficiency of dispersion compensation, and hence decreasing the cost of building a terminal station.

Response to Arguments

6. Applicant's arguments with respect to claims 1-16 and 18-41 have been considered but are moot in view of the new ground(s) of rejection.

In response to Applicant's argument that the Hill teaches away from the claimed invention of three coherent beams of different orders. Examiner asserts that even though Hill teaches the center beam or zero-order beam is being suppressed less than 5% of the

light diffracted by the mask; however Applicant merely teaches a three coherent beam nowhere does the Applicant claim the beam has to be of certain intensity and thus Examiner interprets that the center beam is one of the three beams that is being generated. Further, Hill teaches using the three coherent beams generate the gratings on the fiber, thus Examiner asserts that the Hill reference is valid.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following prior art are cited to further show the state of the art of method and apparatus of composing a grating structure in a photosensitive waveguide.

U.S. Patent No. 4,725,110 to Glenn.

U.S. Patent No. 6,269,208 to Bhatia.

U.S. Patent No. 6,542,690 to Ellison.

U.S. Patent No. 6,694,075 to Bhatia.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dalei Dong whose telephone number is (571)272-2370. The examiner can normally be reached on 8 A.M. to 5 P.M..

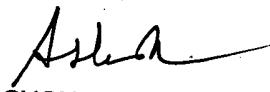
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar Patel can be reached on (571)272-2457. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2879

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

D.D.

May 3, 2004


ASHOK PATEL
PRIMARY EXAMINER